

WHAT IS CLAIMED IS:

1. A material system comprising a substantially close packed array of generally contacting, hollow, individually formed geometric shapes having a coordination number greater than or equal to 1 and having a 70% to 100% dense wall structure, which are bonded together, and which material system has a constrained stabilized porosity and is abradable, thermally insulating, and thermally stable at temperatures up to at least 1600° C.
2. The material system of Claim 1, where the hollow ceramic shapes have walls that have a density of from 70% to 100% of theoretical density.
3. The material system of Claim 1, where there are spaces between the geometric shapes, partly filled with smaller geometric shapes.
4. The material system of Claim 1, where the material system is abradable, thermally insulating, and thermally stable at temperatures from about 1200°C to 1600°C.
5. The material system of Claim 1, where the hollow geometric shapes have a wall thickness greater than about 100 micrometers.
6. The material system of Claim 1, where the hollow ceramic shapes are selected from spherical type shapes and other shapes of low aspect ratio.

7. The material system of Claim 1, where the space between the geometric shapes is at least partly filled with a matrix ceramic binder.

8. The material system of Claim 1, where the geometric shapes are arranged in a three-dimensional chain like structure.

9. The material system of Claim 1, where the system is from 15 vol. % to 90 vol. % porous.

10. The material system of Claim 1, where the coordination number of the hollow shapes is from 3 to 14, and the system is from 40 vol. % to 70% vol. porous for turbine insulating and abradable coatings.

11. The material system of Claim 1, where the coordination number of substantially all of the hollow shapes is from 5 to 8.

12. The material system of Claim 1, where the shapes are hollow spheres having sizes between 200 micrometers and 5000 micrometers diameter.

13. The material system of Claim 1, where the shapes are hollow elongated spheroids or other hollow geometric shapes of low aspect ratio, either randomly oriented or preferentially oriented parallel or perpendicular to the substrate surface and having aspect ratios less than 5-to-1 and lengths between 200 micrometers and 5000 micrometers.

14. The material system of Claim 1, where the hollow shapes are spherical and the wall thickness-to-radius ratio of the hollow spheres are between 0.05 to 0.50.

15. The material system of Claim 1, where the hollow shapes are spherical and any large voids within the hollow spheres are separated by at least 2x the sphere wall thickness.

16. The material system of Claim 1, where the system is disposed on a substrate.

17. The material system of Claim 1, where the system is used as an abradable shroud seal layer in a turbine assembly.

18. The material system of Claim 1, where the system is used as a thermal barrier for vanes, transitions and combustors in a turbine assembly.

19. The material system of Claim 1, where the system is used as a thermal barrier layer on a turbine component in a turbine assembly.

20. A material system consisting essentially of a substantially close packed array of generally contracting, hollow, individually formed hollow spheres having a coordination number of from 5 to 12, a wall thickness greater than about 100 micrometers and a 70% to 100% dense wall structure, which are bonded together into a three-dimensional chain like structure, where the space between the hollow spheres is at least partly filled with a material comprising a matrix ceramic binder, to provide a system that is up from 15 vol. % to 90 vol. % porous, and which material system has a constrained stabilized uniform spherical porosity and is abradable, thermally insulating, and thermally stable at temperatures up to at least 1600°C.